The epidemiology of operations performed by the National Sea Rescue Institute of South Africa

by

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Declaration

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Part A: LITERATURE REVIEW

Introduction

International burden of injuries

Non-natural deaths contribute a noteworthy amount towards the global overall mortality rate.(1)(2) The World Health Organization (WHO) estimated that six of every 10 deaths are due to non-communicable conditions; three due to communicable, reproductive or nutritional conditions; and one due to injuries.(1)(2) Unintentional injuries accounted for over 3.9 million deaths globally in 2004 alone, while in low- and middle- income countries, injuries among men aged 15-44 years may be more than 30% of the total disease burden.(2) Children are also effected with approximately 950 000 children, under the age of 18, dying annually as a result of an injury.(2)(3) Up to 60% of all fatal injuries amongst children were due to unintentional injuries, namely road traffic collisions, drowning, burns, falls or poisoning.(3) Although death is the most noteworthy outcome in injuries, it only represents a small percentage of the total injury burden. A significant proportion of non-fatal injuries result in hospitalization, temporary or permanent disability, and psychological trauma with subsequent financial or educational repercussions. The WHO determined that around 50% of young children that present to hospital with unintentional injuries ended up with some form of disability that had a lifelong impact.(3)

South Africa's burden of injury

South Africa is no exception as 10% of all deaths are deemed non-natural.(4) The 2008 National Injury Mortality Surveillance System revealed that violence-related injuries (31.5%) and transport-related injuries (29.4%) accounted for most of the deaths.(5) Fatal drowning was the cause of 2.3% of all non-natural deaths in 1999 and the second leading cause of death (14.4%) from unintentional injuries in 2008.(5)

Drowning

Global burden of drowning

Drowning has been defined by the WHO as "the process of experiencing respiratory impairment from submersion or immersion in liquid".(1) Drowning is the third leading cause of death by unintentional injury, with more than 370 000 people annually dying.(1) Even more of concern is the fact that drowning occurs among the 10 leading causes of death of children and young people in every region of the world.(1) Furthermore, the overwhelming majority of

drownings are occuring in low- and middle-income countries, resulting in the WHO labelling drowning as a major public health concern.(1)

South Africa's burden of drowning

Poor swimming prowess, easily accessible rivers, lakes and oceans, concomitant alcohol use, limited resources to respond to drowning incidents, and unpatrolled waters contribute to the growing public health burden from drowning in South Africa.(6) In 2008, the National Injury Mortality Surveillance System of South Africa revealed that drowning was the fifth most likely cause of accidental death.(5) Fatal drowning occurred in 1518 people during 2013, totalling 6% of other external causes of accidental injury.(7) However, true numbers of drowning are lacking due to significant underreporting and this number might be substantially higher.(6)

Populations at high risk of drowning

The incidence of drowning is disproportionately high in certain populations. Children are the most vulnerable group and drowning is the second leading cause of death, following motor vehicle collisions, in children between the ages of 1 and 14 years.(3,8,10). Peak drowning rates occur among children aged 1–4 years, followed by children aged 5–9 years. Children less than a year old are immobile and thus less likely to enter water bodies, but are at high risk of drowning in household water containers (e.g. buckets, toilets) not often perceived as a risk. On the other side of the age scale, adolescents are generally less supervised but more prone to engage in risky behaviour.(1) The burden also extends beyond mortality; for every drowning fatality, another five children require emergency care for non-fatal drowning injuries.(8)

Socio-economic status also plays a role. Ninety-one percent of unintentional drowning deaths occur in low- and middle- income countries. The WHO estimated that death due to drowning is 10 to 13 times more likely to occur in the African region than in either Germany or the United Kingdom.(1) Furthermore, it is estimated that the childhood drowning death rate in the African region is eight times higher than in Australia or the United States of America.(1)(10)

Lastly, males are twice as likely as females to drown and drowning rates appear to be disproportionately high among minority populations irrespective of the country's socio-economic status.

Drowning prevention strategies should thus be inclusive of these vulnerable population groups.

Drowning prevention strategies

Drowning can be prevented and proven strategies include:(1)

- Reduced exposure to water hazards through strategic use of barriers
- Close and capable adult supervision for young children
- Improved swimming and water safety skills
- Requirements for use of personal flotation devices
- Comprehensive boating regulations and enforcement
- Signage and designation of hazardous water bodies
- Timely rescue and resuscitation by a trained bystander or lifesaver
- Supervision of recreational swimming areas

Prevention remains vital, as the outcome is often fatal once someone starts to drown. Unlike other injuries, survival after submersion is almost entirely determined at the scene of the incident. Survival is firstly dependent on how swiftly the drowning victim is removed from the water and secondly, how quickly adequate resuscitation is commenced.(1)

Timely search and rescue of potential drowning victims (at sea or inland waters) thus play a crucial role in preventing death.

Search and rescue

Definitions

Search and rescue is defined as an operation initiated by emergency services to find individuals believed to be in distress, ill or injured; and possibly lost in remote areas or areas that are difficult to access.(11) The goal of search and rescue operations is to maximize the likelihood of success (finding victims alive) in the shortest possible time using available resources.

The Canadian Civil Air Search and Rescue Association (CASARA) defines maritime search and rescue as the search for, and provision of aid to persons, ships, or other crafts, which are, or feared to be, in distress or imminent danger. Rescue refers to an operation to retrieve persons in distress, provide for their initial medical or other needs, and deliver them to a place of safety. Maritime search and rescue operations also coordinate and execute the evacuation of seriously ill or injured person(s) from a vessel at sea.(12)

Time as determinant of success

Search and rescue operations are time-critical events. Limiting the time to locate persons in distress is a critical determinant of patient survival. The chance of a successful operation diminishes over time due to several human and environmental factors: exposure, exhaustion, dehydration, and injuries.(13) In general, survivability declines after the first 51-hours of an

incident indicating the importance of initiating search and rescue operations early and locating the victims as soon as possible.(14)

Improving search and rescue outcome

Locating a victim in distress can often take much longer than the actual rescue, and using mathematical models to predict the most likely areas where a lost person may be found have become popular. Modern search theories are rooted in World War II techniques, where detecting enemy submarines spurred the first intensive study on the mathematical basis of searching for objects. The success of military search and rescue operations spurred the U.S. Coast Guard to apply the science of search theory to civil search and rescue attempts during the 1950's.(15) The principles of search theory have since been practically applied to any situation where the objective is to locate a person or object contained in a certain geographic area using the most efficient manner. This includes minimizing the time to detection and thus increasing the probability of success.(15,16) Many variables can be included in such a search model e.g. local conditions (e.g. weather, sea currents), data of previous incidents (e.g. high risk areas) as well as expected behaviour patterns of lost persons (e.g. hikers prefer continued forward motion as opposed to retracing their steps).(15)(13)

Previous search and rescue data can thus be used to understand the full extent and circumstances of the incident, to target interventions and to evaluate their effectiveness. As an example, in their efforts to reduce coastal drowning in the United Kingdom and Ireland, the Royal National Lifeboat Institution (RNLI) analysed fatal incidents between 2010 and 2013 to identify high risk factors. Their data indicated that males, over 55 years of age, low water temperature (<15°C), initial incapacity due to injury, and being alone, are the key contributors to the deaths across most of the activities analysed.(17) Similarly, systemized data from past search and rescue operations are used in Canada, the US, and in Norway to guide future planning.(18)(19)(20) At present, there are no published data on the epidemiology of search and rescue operations in South Africa.

Conclusion

Drowning is a highly preventable global public health challenge and strategic interventions need to be undertaken to reduce the burden. Furthermore, lack of planning and preparedness potentially hinder provision of lifesaving medical care in maritime environments. Analyzing injury mechanisms at sea, and rescue operations associated with incidents in austere and/or

hazardous environments may assist planning and executing future search and rescue operations and improve outcomes through injury prevention strategies.

References

1. WHO Global Report on Drowning: Preventing a leading killer [Internet]. 2014 [cited 2015 Jan 27]. Available from: http://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf?ua=1

2. World Health Organization. The Global Burden of Disease: 2004 update [Internet]. 2004 Update. Geneva, Switzerland; 2008. Available from: http://www.who.int/healthinfo/global_burden_disease/2004_report_update/en/index.html

3. Peden M, Oyegbite K, Ozanne-Smith J, Hyder AA, Branche C, Rahman AKMF et al. World report on child injury prevention. World Health Organization 2008. [Internet]. 2008 [cited 2015 Jan 27]. Available from: http://whqlibdoc.who.int/publications/2008/9789241563574_eng.pdf

4. Mortality and causes of death in South Africa, 2013: Findings from death notification [Internet]. [cited 2015 Feb 2]. Available from: http://beta2.statssa.gov.za/publications/P03093/P030932013.pdf

5. Donson, H. (Ed.).Tygerberg: MRC-UNISA CV& ILP. A Profile of Fatal Injuries in South Africa 2008: 10th Annual Report for South Africa based on the National Injury Mortality Surveillance System. 2009;

6. Matthew J, Robertson C, Hofmeyr R. Update on drowning. South African Med J. 2017 Jun;107(7):562.

7. Mortality and causes of death in South Africa, 2013: Findings from death notification [Internet]. [cited 2015 Feb 2]. Available from: http://beta2.statssa.gov.za/publications/P03093/P030932013.pdf

8. CDC - Water-Related Injuries Facts - Home and Recreational Safety - Injury Center. [cited 2015 Jan 27]; Available from: http://www.cdc.gov/HomeandRecreationalSafety/Water-Safety/waterinjuries-factsheet.html

9. Leavy JE, Crawford G, Leaversuch F, Nimmo L, McCausland K, Jancey J. A Review of Drowning Prevention Interventions for Children and Young People in High, Low and Middle Income Countries. Journal of Community Health. 2016.

10. WHO | Drowning Fact sheet. WHO [Internet]. 2016 [cited 2017 Jan 28]; Available from: http://www.who.int.ez.sun.ac.za/mediacentre/factsheets/fs347/en/

11. Heggie TW. Search and Rescue in Alaska's National Parks. Travel Med Infect Dis. 2008;6(6):355–61.

12. Canadian National Search and Rescue Manual [Internet]. [cited 2015 Jan 13]. Available from: http://www.casara.ca/wp-content/uploads/2012/10/NSM_2000.pdf

13. Sava E, Twardy C, Koester R, Sonwalkar M. Evaluating Lost Person Behavior Models. Trans GIS. 2016;20(1):38–53.

14. Adams AL, Schmidt TA, Newgard CD, Federiuk CS, Christie M, Scorvo S, et al. Search Is a Time-Critical Event: When Search and Rescue Missions May Become Futile. Wilderness Environ Med. 2007;18(2):95–101.

15. Cooper DC, Frost JR, Robe RQ, VA. PMGA. Compatibility of Land SAR Procedures with Search Theory. [Internet]. Ft. Belvoir: Defense Technical Information Center; 2003. Available from: http://handle.dtic.mil/100.2/ADA511658

16. Koopman BO. Search and screening : general principles with historical applications. Elmsford, N.Y.: Pergamon Press; 1980.

17. Michalaki A, Wright M. Helping to prevent drowning at sea : understanding common factors in fatal incidents. 2015;

18. Marven C, Canessa R, Keller P. Exploratory Spatial Data Analysis to Support Maritime Search and Rescue Planning. In: Li J, Zlatanova S, Fabbri A, editors. Geomatics Solutions for Disaster Management SE - 18 [Internet]. Springer Berlin Heidelberg; 2007. p. 271–88. (Lecture Notes in Geoinformation and Cartography). Available from: http://dx.doi.org/10.1007/978-3-540-72108-6_18

19. National Search and Rescue Manual Volume I: National Search and Rescue System [Internet]. [cited 2015 Jan 29]. Available from: http://www.public.navy.mil/surfor/Documents/3-50-1_Vol1.pdf

20. JUSTICE TRMO, PLANNING DOCEAR. The Norwegian Search and Rescue Service / Informasjonshefter / Redningstjenesten / Redningsnett - Redningsnett [Internet]. 2002 [cited 2015 Jan 29]. Available from: http://www.redningsnett.no/Redningstjenesten/Informasjonshefter/The-Norwegian-Search-and-Rescue-Service

Part B: MANUSCRIPT IN ARTICLE FORMAT

As submitted to International Maritime Health

Title page

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ABSTRACT

Background

Injuries remain a major contributor of morbidity and mortality worldwide, with drowning accounting for 7% of all injury-related deaths with rates of between 4 and 8 per 100000. The African region has death rates comparable to most low-income countries. Non-fatal drowning in Africa remains unquantified but it is estimated to be ten times higher than the fatal drowning rate. Timely search and rescue, initial resuscitation and rapid transportation to definitive care play a crucial role in preventing injury-related morbidity and mortality. The National Sea Rescue Institute (NSRI) of South Africa is a non-profit organization responsible for ~97% of maritime search and rescue operations in South Africa (including inland navigable waters).

Objective

To describe the epidemiology of operations performed by the National Sea Rescue Institute of South Africa over a 5-year period.

Methods

The NSRI operational database was analyzed from 1 January 2010 to 31 December 2014. Summary statistics are presented.

Results

The NSRI launched 3281 operations over the study period. Marked seasonal variation were noticeable with peak periods in December and January, corresponding to the South African summer holiday season. Water-based operations (67.6%) were the most frequent operation performed. The NSRI assisted 3399 individuals of which 77% were male. The mean age of rescued persons was 42 years. Eight hundred and thirty-six individuals (25%) had non-fatal injuries or illnesses requiring medical assistance. Medical emergencies (35%), traumatic injuries (32.8%), and non-fatal drownings (23%) were the most common types of injury and illness. The majority of the 184 (18%) deaths recorded were due to drowning (75%).

Conclusion

Injury and illness, specifically drowning utilize a large proportion of search and rescue services. The results may further preventative measures and public health strategies to minimize traumatic and medical incident severity and subsequent casualties at sea.

INTRODUCTION

Non-natural deaths globally contribute significantly towards overall mortality. Injuries remain a major contributor of morbidity and mortality, accounting for more than 9% of total deaths worldwide.(1) South Africa is no exception as 11.1% of all deaths are deemed non-natural, which includes fatal motor vehicle accidents, assault, self-harm, and fatal drowning.(2)

Drowning has been defined by the World Health Organization (WHO) as "the process of experiencing respiratory impairment from submersion or immersion in liquid".(1) More than 370 000 people die every year from drowning and over half of global drowning deaths are in persons younger than 25 years.(1) Males are twice as likely as females to drown, while drowning rates in low- and middle-income countries are more than three times higher than in high-income countries.(1) This undoubtedly warrants drowning to be labelled as a globally neglected public health issue.(1) In South Africa fatal drowning occurred in 1411 people during 2015, totaling 4.4% of other external causes of accidental injury.(2) However, true numbers of drowning are lacking and this number might be substantially higher.(3) The National Sea Rescue Institute of South Africa (NSRI) estimates that more than 2000 people die every year from drowning, 600 of which are children (personal communication: Dr C Robertson, August 2017). These estimates are extrapolated from mortuary data in the Western Cape Province, but many drowning victims simply disappear in rivers, dams and the sea and it is likely that drowning is significantly under reported.

Drowning is a highly preventable public health challenge and strategic interventions need to be undertaken to reduce the burden. Fundamental preventative strategies, especially in the young, include effective safety measures and barriers to control access to water (solid pool covers, pool fencing), improving water confidence and swimming skills, knowledge of rip currents, swimming on lifeguarded beaches, access to beach rescue equipment, warning signage, wearing of lifejackets by water users, bridges across rivers in rural areas, wetsuits or safe buoyancy aids for children, training bystanders and strengthening public awareness of drowning.(1,4) Timely search and rescue of potential drowning victims (at sea or inland waters), initial appropriate resuscitation and rapid transportation to a medical facility also play a crucial role in preventing death.

Search and rescue (SAR) is defined as an operation initiated by emergency services to find individuals believed to be in distress, ill or injured; and possible lost in remotes areas or areas that are difficult to access.(5) Search and rescue response is generally required in undeveloped, or extreme environments where misadventures tend to occur and modern emergency services

or equipment are unable to reach. In order to locate the victim or vessel in distress, SAR personnel are exposed to the same inherent risks associated with wilderness, mountain and maritime activities.(5) The goal of SAR operations is to maximize the likelihood of success as swiftly as possible using available resources. The decision to terminate search and rescue efforts, if a victim is not found timeously, or to change to a search and recovery operation should be made based on the probability of survival.(6) Abandoning search and rescue efforts as the likelihood of survival diminishes, may reduce the risk to rescuers and conserve resources.(6)

Maritime search and rescue is a subcomponent of search and rescue and has been defined by the Canadian Civil Air Search and Rescue Association (CASARA) as the search for, and provision of aid to persons, ships, or other crafts, which are, or feared to be, in distress or imminent danger. The rescue component denotes the part of the operation to retrieve persons in distress, provide for their initial medical or other needs, and deliver them to a place of safety.(7) The NSRI is a non-profit organization responsible for the majority of search and rescue response along the South African coast and on inland navigable waters.(8) The NSRI consists of 31 coastal rescue stations, 5 inland dam bases, a fleet of 96 rescue crafts and +/- 1000 volunteers.(8) They assist with medical evacuations of crew from ships passing along the South African coastline, as well as commercial and subsistence fishermen. Rescue services also extend to recreational skiers, kite-surfers, windsurfers, surfers, sailors, and bathers requiring assistance at sea.(8)

Motivation

Systemized data from past search and rescue operations are crucial to current responses throughout the world.(9)(10)(11) For example, data can be used to identify high probability areas in certain regions. These areas can be explored beforehand to map relevant geographical features, to determine the swiftest access and egress routes, and to anticipate possible hazards that could be detrimental during a search and rescue operation. This will all help to ensure recovery of persons and vessels and limit patient mortality.

At present, there are no published studies describing the epidemiology of maritime search and rescue operations in South Africa. The paucity of data hampers the planning and execution of future search and rescue operations and are hindering the provision of lifesaving medical care in maritime environments. This study aimed to describe all search and rescue operations by the National Sea Rescue Institute of South Africa over a 5-year period.

MATERIALS AND METHODS

Study design

A retrospective analysis of operations conducted by the South African National Sea Rescue Institute over a 5-year period. The study was approved by the Health Research Ethics Committee at Stellenbosch University (Ref: S15/02/036).

Study setting and participants

Standardized operation capture forms (Appendix 1) are completed after each mission by the NSRI shore controllers or the coxswains in charge which are then crosschecked by the rescue base Station Commander. Operation reports include demographic details and predefined data fields that record information about the incident as well as a narrative description of most cases. Validated crosschecked data is captured and individually stored on the NSRI Management Information System (MIS).

Operation reports of operations conducted from 1 January 2010 to 31 December 2014 were eligible for inclusion. Operation reports with incomplete data points relating to operation date or time, operation category and type, mission statistics and description were excluded from analysis. All double entries were also excluded.

Data collection and management

Data from individual operation reports were manually incorporated into a Microsoft Excel® spreadsheet. Collected variables related to general mission information (operation number, region, and category), operation details (date, time, location), weather conditions (wind, swell, visibility) and demographics describing the rescued craft and person(s). Operations were categorized into four groups: i) Air-based search and rescue, ii) Land-based search and rescue, iii) Water-based search and rescue, and iv) Support services. Further subcategorization was done per incident type.

Statistical analysis

Statistical analysis was done using Microsoft Excel®, and summary statistics were used to describe all variables.

RESULTS

The NSRI performed 3281 operations over the 5-year period. Thirty-five operations (1.1%) were excluded due to incomplete data points with 3246 operations subsequently included in the analysis (mean per year = 649.2). Annual operations peaked during 2013 (n=709, mean per

month = 59.1) (Figure 1) and a marked seasonal variation were revealed with peak periods in summer months (December and January) (Figure 2). The busiest month was December 2012 when 117 operations were performed.

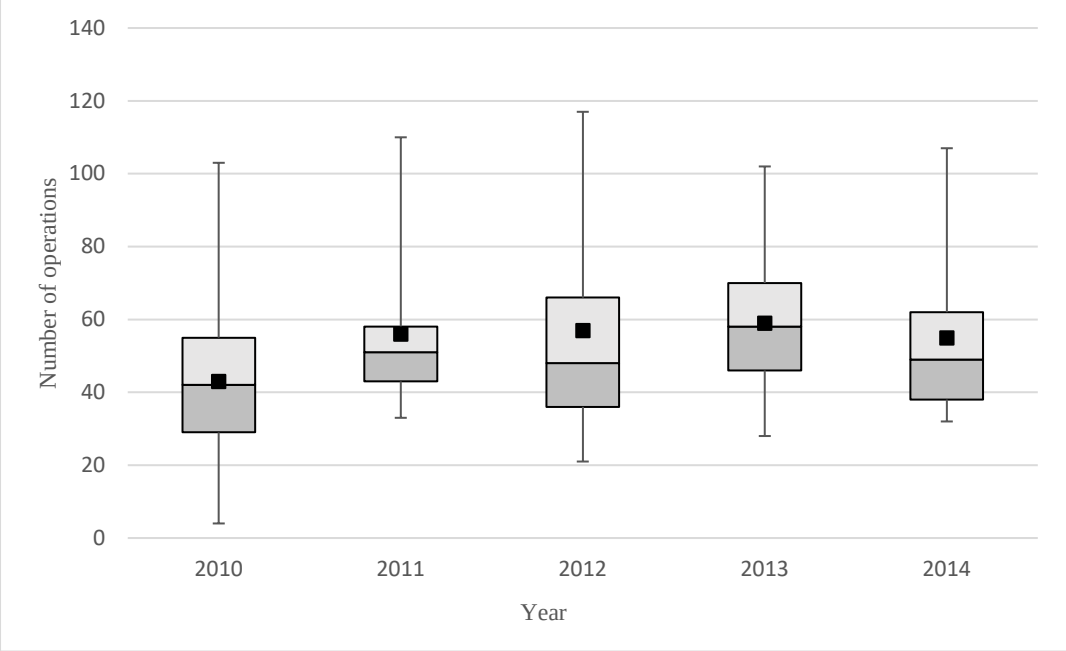

Figure 1 Annual operations performed by the National Sea Rescue Institute (black square represents the mean; endpoints of whiskers represent upper and lower extremes)

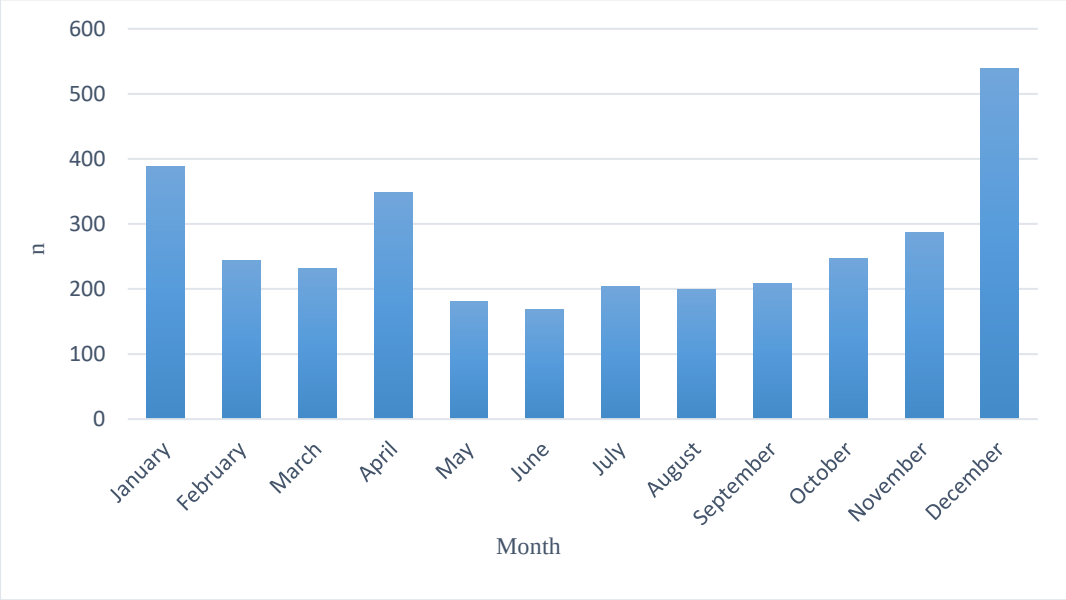

Figure 2 Monthly operations performed by the National Sea Rescue Institute of South Africa from January 2010 till December 2014

Most operations occurred in the south-western coastal regions (n=1467, 45.2%) (Figure 3).

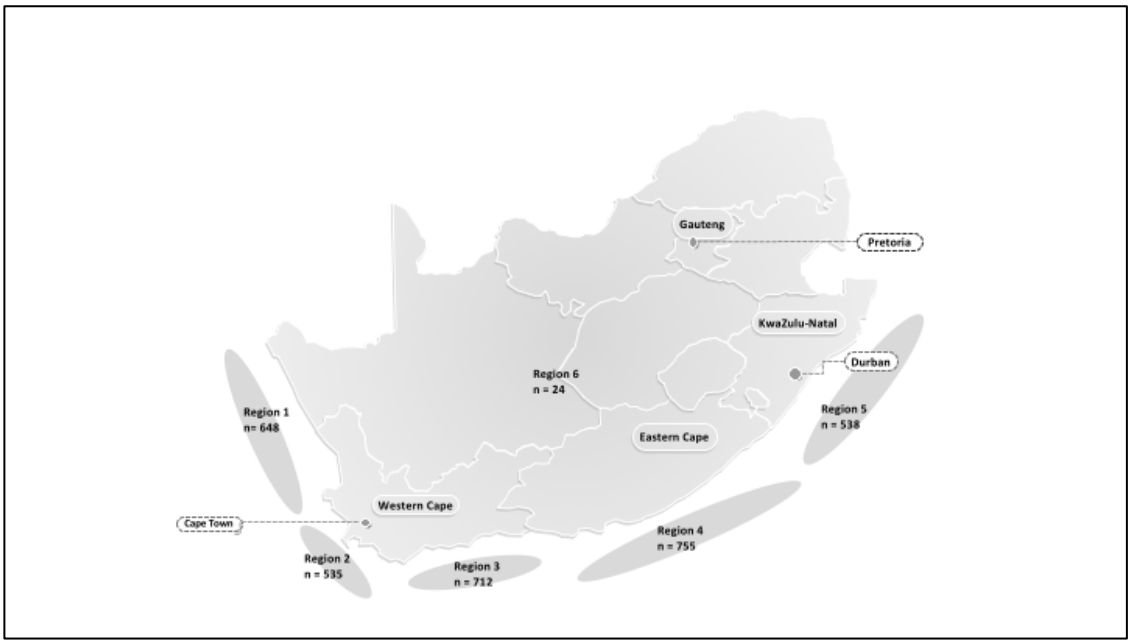

Figure 3 National Sea Rescue Institute operations per region for the 5-year period (Region 1: Lamberts Bay to Kommetjie; Region 2: Simons Town to Agulhas; Region 3: Witsand to Plettenberg Bay; Region 4: Oyster Bay to East London; Region 5: Richards Bay to Port St Johns; Region 6: Inland)

Water-based assistance was the most frequent type of operation performed (n=2194, 67.6%), followed by land-based search and rescue (n=341, 10.5%) and air-based search and rescue (n=42, 1.3%). The NSRI further assisted during floods, firefighting, motor-vehicle accidents, whale disentanglement, crew replacement of vessels at sea, and body recovery searches (support services n=669, 20.6%).

Water-based operations mostly related to medical evacuations of people aboard vessels at sea (n=269, 12.3%), assisting small vessels (9m or less) in need (n=264, 12%) and drownings (n=230, 10.5%).

Sporting activities lead to 493 rescues; predominantly paddle-sport activities (185/493, 37.5%), swimmers/divers (138/493, 28%), and surfers/kite-surfers/windsurfers (122/493, 24.7%). In total, 1021 boats were assisted (553 towed); mostly sports and recreational crafts (737/1021, 72.2%) and commercial fishing crafts (277/1021, 27.1%). The mean distance travelled offshore was 4.8km (Standard Deviation (SD) 13.7, maximum 180km) and mean distance travelled from base 11.5km (SD 23.8, maximum 370km).

Land-based search and rescue response (n=341, 10.5%) included 50 (14.7%) marooned persons or mountain hikers, of which 16 required medical evacuation.

The prevailing weather conditions at the time of the operation were recorded in 3209 (98.9%) operations. South Easterly winds (1031/3209, 32.1%) with swells of 1-2m (1296/3209, 40.4%) predominated (Table 1).

Wind direction, n (%)		**Wind force, n (%)**		**Swells, n (%)**	
South East	1031 (31.8)	**Force 0 - Calm (< 1 km/h)**	382 (11.8)	**< 1m**	917 (28.2)
South West	766 (23.6)	**Force 1 - Light air (1-5 km/h)**	714 (22)	**1m - 2m**	1296 (40)
North East	392 (12.1)	**Force 2 - Light breeze (6-11 km/h)**	644 (19.8)	**2m - 3m**	626 (19.2)
North West	302 (9.3)	**Force 3 - Gentle breeze (12-19 km/h)**	468 (14.4)	**3m - 4m**	208 (6.4)
West	241 (7.4)	**Force 4 - Moderate breeze (20-28 km/h)**	346 (10.7)	**4m - 5m**	96 (3)
East	185 (5.7)	**Force 5 - Fresh breeze (29-38 km/h)**	257 (7.9)	**5m - 6m**	32 (1)
South	179 (5.5)	**Force 6 - Strong breeze (39-49 km/h)**	251 (7.7)	**6m - 7m**	17 (0.5)
North	113 (3.5)	**Force 7 - Near gale (50-61 km/h)**	99 (3)	**7m - 8m**	7 (0.2)
Not indicated	37 (1.1)	**Force 8 – Gale (62-74 km/h)**	44 (1.4)	**8m - 9m**	2 (0.1)
		Force 9 - Severe gale (75-88 km/h)	6 (0.2)	**9m - 10m**	1 (0.03)
		Force 10 – Storm (89-102 km/h)	3 (0.1)	**Not indicated**	44 (1.4)
		Not indicated	32 (1)		

Table 1 Weather conditions associated with operations performed by the National Sea Rescue Institute of South Africa

The NSRI assisted 3399 individuals (mean per operation = 2, maximum per operation = 39). Males accounted for 77% (2491/2372) of those requiring assistance. The mean age of rescued persons was 42 years (SD 24.6) with adults between 20 and 29 years of age (509/2896, 21.5%) the biggest proportion (Table 2).

Age (years)	n (%)
0-12	115 (4.8)
13-19	232 (9.8)
20-29	509 (21.5)
30-39	487 (20.5)
40-49	470 (19.8)
50-59	348 (14.7)
>60	211 (8.9)

Table 2 Rescued persons assisted by the National Sea Rescue Institute of South Africa according to age group

In total, 836 (25%) individuals had non-fatal injuries or illnesses requiring medical assistance. Medical emergencies (293/836, 35%), traumatic injuries (274/836, 32.8%), and non-fatal drownings (192/836, 23%) were the most frequent types of injury and illness (Figure 4).

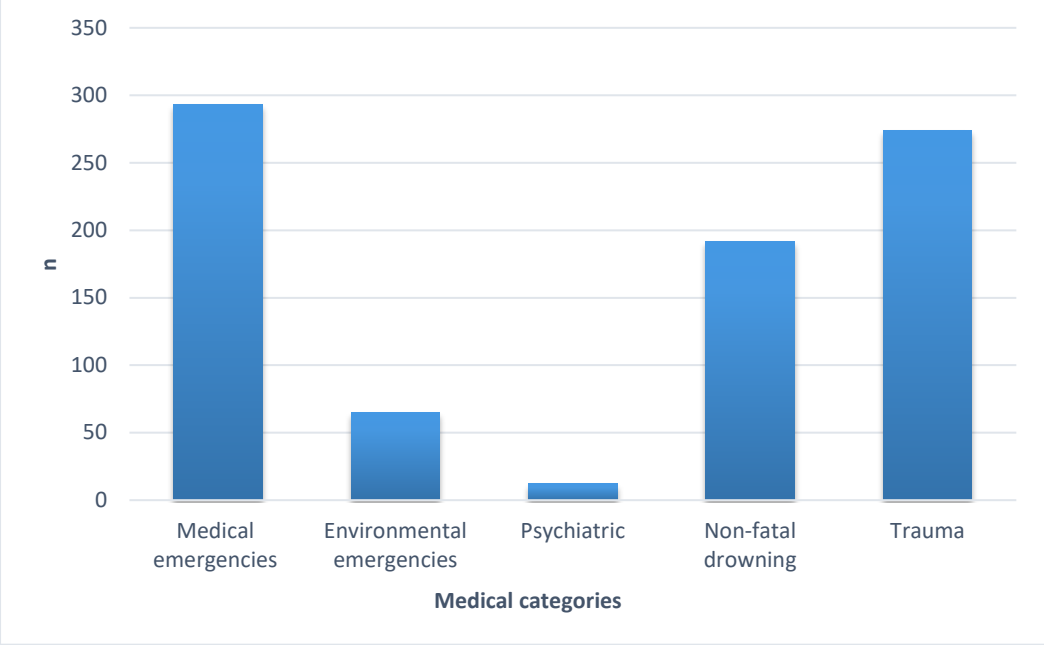

Figure 4 Distribution of individuals requiring medical assistance by the National Sea Rescue Institute of South Africa during the 5-year study period

There were 184 (18%) deaths recorded; drowning the most frequent cause (138/184, 75%) (Table 3). Ten of the cardiovascular-related deaths were suspected to be from myocardial infarction. Two suicides occurred where the persons jumped to their death.

Cause of death	**n (%)**
Fatal drowning	**138 (75)**
Medical related death	**17 (9.2)**
- *Cardiovascular*	*16 (8.7)*
- *Asthma*	*1 (0.5)*
Trauma related death	**16 (8.7)**
- *Falls*	*10 (5.4)*
- *Head injuries*	*2 (1.1)*
- *Shark attack*	*2 (1.1)*
- *Motor-vehicle/ motorcycle accident*	*1 (0.5)*
- *Gunshot wound*	*1 (0.5)*
Unknown	**13 (7.1)**
Total	**184 (100)**

Table 3 Cause of death of individuals assisted by the National Sea Rescue Institute of South Africa during the 5-year study period

DISCUSSION

The purpose of this study was to describe the epidemiology of rescue operations performed by the National Sea Rescue Institute of South Africa over a 5-year period.

The NSRI performed a mean of 649 operations per year from 2010 to 2015, with 709 operations the most in a calendar year (2013). This seems very little compared to the Royal National Lifeboat Institution, serving the coasts of the United Kingdom and the Republic of Ireland, which consistently launched more than 8000 lifeboats per annum.(12)(13) Similarly, other

European marine search and rescue institutions performed more than 2000 operations per year, including Germany's DGzRS, Deutsche Gesellschaft zur Rettung Schiffbrüchiger (2019 missions in the North and Baltic Seas during 2016), France's Les Sauveteurs En Mer (3552 missions around the French Coast in 2015), and Norway's Redningsselskapet (assisting 6447 boats in the coastal waters of Norway during 2016.(14)(15)(16) However, one should be cautious to directly compare marine search and rescue institutions as they differ in too many aspects e.g. amount of ship traffic, persistent weather conditions, fleet size, etc.

Distinct seasonal variation in the number of search and rescue operations was observed, with peak periods in December and January. This finding is not surprising as it coincides with the summer holiday season in South Africa and is consistent with data from North American and Canadian National Parks where the largest proportion of operations were launched during the Northern Hemisphere summer (May to July).(5,17,18) During the warm holiday season, holiday-goers are participating in water-based recreational and sporting activities (swimming, diving, surfing, kayaking, kite-surfing). Kitesurfing is favored by extreme water-sports enthusiasts and South Africa (especially Cape Town) is becoming a very popular kitesurfing destination. This inevitably leads to an increase in sea rescues relating to kitesurfing.(19)

Fortunately, most people assisted by the NSRI were not ill or injured (n=2379, 70%). A negligible difference was found between medical emergencies and trauma in the 836 injured individuals rescued (35% versus 32.8%). Our data emphasize the need for search and rescue personnel to be able to manage a diverse range of medical problems, and to be sufficiently skilled in managing trauma and drowning cases.

Drowning remains a serious public health concern, claiming approximately 324 000 lives globally in 2015 alone. The WHO estimates drowning rates to be more than three times higher in low- and middle-income countries compared to high-income countries.(1,20) South Africa had 3.19 deaths per 100 000 people due to drowning in 2015, which is considerably higher compared to the United Kingdom (0.6/100 000) and Germany (0.69/100 000). (21) Despite the higher incidence of drowning in South Africa, there remains a paucity in drowning-related data and further studies, specifically focusing on drowning, are recommended.

Local perspective

The challenge for the NSRI is that it is a volunteer organization staffed by personnel with limited emergency medical training beyond basic emergency care. Access to more advanced training by existing volunteers is limited by the training regime approved by the Health

Professions Council of South Africa. The only solution available to the NSRI is to recruit trained professional emergency care providers to its ranks or to solicit support at the time of an incident. Ad hoc crew deployments without adequate sea going experience carry reasonable risk to both rescuer and patient.

The rescue of patients from ships at sea, by boat, provides unique challenges. For example, climbing twenty meters up a pilot ladder, 'rescuing' the patient from inside the ship and then lowering them down between two objects moving in three dimensions requires experience and skill not taught in land-based institutions. Specialist training facilities are required. Helicopter rescue would be a solution but sufficient capacity and competence does not exist along the entire coastline.

Lastly, rescue tools and equipment need to be adapted for the maritime environment and the NSRI is constantly innovating to ensure patient and crew safety. Vacuum mattresses provide thermal, physical and float protection at sea and could be more widely used. The NSRI uses waterproof dry bags to package 'jump' bags and electronic equipment but water contamination is common and the cost of replacement high.

LIMITATIONS

The study was limited to South Africa and may not be representative of other African countries. As the NSRI mainly focuses on coastal and navigable water environments, there is a predilection towards incidents occurring on water. Nonetheless, as the first report of such nature, we believe it aids the existing knowledge gap.

Medical information was recorded by multiple sources with various levels of medical training. This resulted in an inherent level of inconsistency in reporting as only symptoms and not the final diagnosis was often documented.

As this study is a retrospective analysis of a pre-existing database, there is no external method available to confirm that the Station Commander appropriately declared a rescue operation or if NSRI rescue personnel accurately recorded data at the time of the operation or whether data was entered correctly onto the NSRI Management Information System (MIS) database. Transcription errors may have occurred when data was captured onto MIS. However, all NSRI personnel are trained on the completion of the rescue mission reports and are routinely subjected to an internal quality assessment. The rescue base Station Commander crosschecks and validates the completed operation form prior to submitting it for entry onto the MIS database. Both these factors should ensure the quality of the data, while minimising missing

data points. Incomplete data forms with missing variables may also limit the reliability and the generalizability of the study's results.

CONCLUSION

There is a paucity of literature describing marine rescues in South Africa. This descriptive study comprising rescue operations over a 5-year period, provides the first documented account of work carried out by the National Sea Rescue Institute of South Africa. The findings of this study will better inform further research studies within the field of sea rescue and can thus be used to develop search and rescue strategies as well as training. The results may also further preventative measures and public health strategies to minimize traumatic and medical incident severity and subsequent casualties at sea.

REFERENCES

1. WHO Global Report on Drowning: Preventing a leading killer [Internet]. 2014 [cited 2015 Jan 27]. Available from: http://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf?ua=1

2. Mortality and causes of death in South Africa, 2015: Findings from death notification. 2017 [cited 2017 Sep 15]; Available from: http://www.statssa.gov.za/publications/P03093/P030932015.pdf

3. Matthew J, Robertson C, Hofmeyr R. Update on drowning. South African Med J. 2017 Jun;107(7):562. DOI 10.7196/SAMJ.2017.v107i7.12609

4. Leavy J, Crawford G, Leaversuch F, Nimmo L, McCausland K JJ. A Review of Drowning Prevention Interventions for Children and Young People in High, Low and Middle Income Countries. J Community Health [Internet]. [cited 2017 Aug 23];41. Available from: https://link-springer-com.ez.sun.ac.za/content/pdf/10.1007%2Fs10900-015-0105-2.pdf DOI 10.1007/s10900-015-0105-2

5. Heggie TW. Search and Rescue in Alaska's National Parks. Travel Med Infect Dis. 2008;6(6):355–61. DOI 10.1016/j.tmaid.2008.07.002

6. Adams AL, Schmidt TA, Newgard CD, Federiuk CS, Christie M, Scorvo S, et al. Search Is a Time-Critical Event: When Search and Rescue Missions May Become Futile. Wilderness Environ Med. 2007;18(2):95–101. DOI 10.1580/06-WEME-OR-035R1.1

7. Canadian National Search and Rescue Manual [Internet]. [cited 2015 Jan 13]. Available from: http://www.casara.ca/wp-content/uploads/2012/10/NSM_2000.pdf

8. About Us | nsri.org.za [Internet]. [cited 2015 Jan 12]. Available from: http://www.nsri.org.za/about/

9. Ministry of Justice and Police. The Norwegian Search and Rescue Service [Internet]. 2002. Available from: www.redningsnett.no/Redningstjenesten/Informasjonshefter/The-Norwegian-Search-

and-Rescue-Service

10. Marven C, Canessa R, Keller P. Exploratory Spatial Data Analysis to Support Maritime Search and Rescue Planning. In: Li J, Zlatanova S, Fabbri A, editors. Geomatics Solutions for Disaster Management SE - 18 [Internet]. Springer Berlin Heidelberg; 2007. p. 271–88. (Lecture Notes in Geoinformation and Cartography). Available from: http://dx.doi.org/10.1007/978-3-540-72108-6_18

11. National Search and Rescue Manual Volume I: National Search and Rescue System [Internet]. [cited 2015 Jan 29]. Available from: http://www.public.navy.mil/surfor/Documents/3-50-1_Vol1.pdf

12. Royal National Lifeboat Institution (GB). Royal National Lifeboat Institution (GB) [Internet]. 2016 [cited 2017 May 1]. Available from: https://rnli.org/

13. Riley D. Storms and statistics - another lifesaving year for the RNLI - News on Sailing Networks [Internet]. RNLI. 2016 [cited 2017 Aug 31]. Available from: http://www.sailingnetworks.com/news/read/35816

14. German Maritime Search, and Rescue Association. The Deutsche Gesellschaft zur Rettung Schiffbrüchiger (DGzRS) [Internet]. 2016 [cited 2017 May 1]. Available from: https://www.seenotretter.de/en/who-we-are/portrait/

15. The SNSM association. Les Sauveteurs En Mer [Internet]. 2015 [cited 2017 May 7]. Available from: https://www.snsm.org/page/bilans

16. Redningsselskapet. Redningsselskapet. The Norwegian Society for Sea Rescue [Internet]. 2016 [cited 2017 May 16]. Available from: https://www.redningsselskapet.no/english/

17. Ela GK. Epidemiology of Wilderness Search and Rescue in New Hampshire, 1999–2001. Wilderness Environ Med. 2004;15(1):11–7. DOI 10.1580/1080-6032(2004)015[0011:EOWSAR]2.0.CO;2

18. Wild FJ. Epidemiology of Mountain Search and Rescue Operations in Banff, Yoho, and Kootenay National Parks, 2003–06. Vol. 19, Wilderness & Environmental Medicine. 2008. DOI 10.1580/07-WEME-OR-141.1

19. Exadaktylos AK, Sclabas GM, Blake I, Swemmer K, McCormick G, Erasmus P. The kick with the kite: an analysis of kite surfing related off shore rescue missions in Cape Town, South Africa. Br J Sport Med [Internet]. 2005 [cited 2017 Feb 18];39. Available from: http://www.bjsportmed.com/cgi/content/full/39/5/e26 DOI 10.1136/bjsm.2004.014795

20. WHO | Drowning Fact sheet. WHO [Internet]. 2016 [cited 2017 Jan 28]; Available from: http://www.who.int.ez.sun.ac.za/mediacentre/factsheets/fs347/en/

21. Seattle, WA: IHME U of W. Institute for Health Metrics and Evaluation (IHME). GBDCompareDataVisualization. [Internet]. Available from http:// vizhub.healthdata.org/gbd-compare. 2016 [cited 2017 May 16]. Available from: https://vizhub.healthdata.org/gbd-compare/

APPENDICES

Appendix 1

Sea Rescue
NATIONAL SEA RESCUE INSTITUTE

Activity Capture Form				
Rescue Station:	Weather		Wind speed	
Other Stations Involved:	visibility		wind direction	
Start Date			Sea State (force)	
Start Time				
End Date				
End Time				
Activity Location:			coordinates	
Describe the Activity:				
	Asset 1	**Asset 2**	**Asset 3**	**Asset 4**
NSRI Rescue Units used:				
launch time				
recover time				
Start hrs				
End Hrs				
Water / oil added				
Fuel used: litres				
Sea Rescue Crew involved (& Role) (list in column per asset served)				
Non Sea Rescue Assets used:				
Non Sea Rescue personnel involved				
Final Comments:				

Part C: SUPPORTING DOCUMENTATION

Proposal

The epidemiology of operations performed by the National Sea Rescue Institute of South Africa

Principle Investigator: Dr. E Erasmus
Registrar
Division of Emergency Medicine
University of Stellenbosch

Supervisor: Dr. DJ van Hoving
Division of Emergency Medicine
University of Stellenbosch

1. Introduction

1.1 Background

Non-natural deaths globally contribute a fair amount towards overall mortality. Injuries remain a major contributor of morbidity and mortality, accounting for more than 9% of total deaths worldwide. (1) In 2012, an estimated 372 000 people died from drowning incidents, earmarking drowning as the third leading cause of death by unintentional injury. The global burden and mortality from drowning, totaling 7% of all injury-related deaths, led the World Health Organization (WHO) to label drowning as a major public health concern. (1)

Drowning is the second leading cause of death, in children between the ages of 1 and 14 years following fatal motor vehicle accidents. (2,3) Ninety-one percent of unintentional drowning deaths occur in low- and middle- income countries. According to the WHO, death by drowning is 10-13 times more likely in the African Region than either Germany or the United Kingdom respectively, accounting for the highest drowning death rates worldwide. (1)

In South Africa, 10% of all deaths were deemed non-natural, which includes fatal motor vehicle accidents, assault, self-harm, and death by drowning. In 2013, accidental drowning and submersion were responsible for 1518 deaths, totaling 6% of all other external causes of accidental injury.(4)

Drowning is a highly preventable public health challenge and strategic interventions need to be undertaken to reduce the burden. Effective safety measures and barriers to control access to water, improving swimming skills, training bystanders and strengthening public awareness of drowning are fundamental preventative strategies, especially in the young. Timely search and rescue of potential victims at sea or inland waters, initial provision of resuscitation as well as rapid transportation to a medical facility also play a crucial role in preventing death from drowning.

The Canadian Civil Air Search and Rescue Association (CASARA) has defined maritime search and rescue as the search for, and provision of aid to persons, ships, or other crafts, which are, or feared to be, in distress or imminent danger. Rescue refers to an operation to retrieve persons in distress, provide for their initial medical or other needs, and deliver them to a place of safety. Maritime search and rescue operations also coordinate and execute the evacuation of seriously ill or injured person(s) from a vessel at sea. (5)

Maritime incident data collection is crucial for the planning and execution of maritime search and rescue operations. The Canadian Coast Guard Auxiliary (CCGA), operating in conjunction with the Canadian Coast Guard, is a volunteer based non-profit organization dedicated to search and rescue around the Canadian coastline. They execute approximately 25% of the 8000 search and rescue operations per year, which equates to 200 lives saved annually.(6) The Canadian Coast Guard depends on historical site-specific maritime incident data collection for all maritime emergency search and rescue response.(7) The United States Coast Guard sponsored the Interagency Committee of Search and Rescue (ISCAR) to prepare a National Search and Rescue Manual based on accrued experience, thorough research and development of search theories.(8) Similarly, search and rescue teams in Norway face many challenges arising from the topography, harsh climate and coastal shipping traffic. Systemized data from past search and rescue operations are crucial to current responses on Norwegian waters.(9)

The National Sea Rescue Institute (NSRI) in South Africa plays a key role in local maritime search and rescue efforts, and performs approximately 97% of sea rescue operations around the South African coast.(10) In 2014 the NSRI executed 662 search and rescue operations, during which 1131 persons were assisted, totaling 3992 operational hours.(11)

1.2 Motivation

Search and rescue at sea is a complex combination of art and science, due to the multivariable nature of rescues. SAR operations rely heavily on the experience and creativity of rescuers to individualize a rescue mission to different scenarios and conditions. However, a successful

rescue operation also depends on thorough research of past encounters, strategizing and planning prior to coordination and implementation. If historic cases are archived, mapped and made accessible; search and rescue teams would be able to analyze location-specific rescue techniques and previous search incident outcomes. By using local incident data, terrain and environmental conditions, rescue centers could potentially prioritize search areas, and optimize rescue strategies.

At present, there are no studies describing the epidemiology of search and rescue operations in South Africa. There is a definite lack of collective data analyzing injury mechanisms at sea, and rescue operations associated with incidents in this austere environment. The scarcity of published literature on the occurrence of sea rescue missions hampers planning and executing future search and rescue operations. Furthermore, lack of planning and preparedness potentially hinder provision of lifesaving medical care in maritime environments.

1.3 Research question

What is the epidemiology of the National Sea Rescue Institute's operations in South Africa?

1.4 Aim

- To describe the epidemiology of all National Sea Rescue Institute operations between 2010 and 2014.

2. Methodology

2.1 Study design

A retrospective analysis of all operations performed by the National Sea Rescue Institute of South Africa over a five-year period (1 January 2010 to 31 December 2014).

2.2 Study setting

The National Sea Rescue Institute (NSRI) is a non-profit organization responsible for both rescue response on inland navigable waters and maritime rescue along the South African

coast.(11) Operating from a central head office, 31 coastal bases and 4 inland bases; it provides coverage of approximately 3000 km of coastal waters and 1300km of inland dams.(11) The NSRI is manned by over 900 trained volunteers and operates a fleet of 90 rescue crafts, 28 rescue vehicles, 10 quad bikes and 10 tractors.(12) Rescue services encompass medical evacuations of crew on board ships docked in South African ports, as well as commercial and subsistence fishermen. The NSRI also respond to recreational skiers, kite-surfers, windsurfers, surfers, sailors, and bathers requiring assistance at sea. (11)

Standardized operation capture forms (Appendix 1) are completed after each mission by the NSRI shore controllers or the coxswains in charge. The rescue base Station Commander crosschecks and validates the completed operation form prior to submitting it to the NSRI Management Information System (MIS). Validated crosschecked data is then captured onto MIS by shore controllers. The NSRI database is securely held behind a Vodacom firewall with limited direct access. Access to the database require Vodacom clearance and is mostly limited to information technology (IT) providers. At station level, users have variable degrees of access to different amounts of data, dependent on designation and functionality.

2.3 Study population

All mission reports in the NSRI database will be analyzed for the period 1 January 2010 till 31 December 2014. Incomplete data points will be excluded from analysis.

2.4 Data collection and management

The operation reports are stored as separate documents on the NSRI Management Information System and data will be manually incorporated into a Microsoft Excel spreadsheet by the principal investigator. Ten percent of entries will be crosschecked by a research assistant. The data will be stored on a password-protected computer.

The following variables will be collected from mission reports:

- General mission information:
  - Operation number
  - Region and station
  - Call date and time
  - Completion date and time
  - Total mission time
  - Notification details
  - Operation category and type
  - Other organizations involved
- Mission statistics
  - Lives saved
  - Persons assisted
  - Boats towed/assisted
- Conditions
  - Wind direction and force
  - Swell height
  - Visibility
- Location
  - Latitude and longitude
  - Location description
  - Distance offshore and from base
- Category and type
  - Number of persons on board
  - Nature of incident
- Demographics and details of rescued persons
  - Nationality
  - Age
  - Gender
  - Lifejacket use
  - General condition and injuries sustained (including injury severity)

2.5 Statistical analysis

Summary statistics will be used to describe all variables. Mean and standard deviation will be used to describe numerical data. Central tendency for ordinal variables will be measured by medians. Range, percentages, proportions or inter-quartile range will be used as measures of variability. The mode will be used as the measure of central tendency for nominal variables. Frequency tables will illustrate distribution of data.

Statistical data analysis will be performed by the principal investigator using Microsoft Excel.

2.6 Time schedule

	February 2015	May 2015	June 2015	July 2015	August 2015	September 2015	October 2015
Ethics Submission	x						
Data collection & management		x	x				
Statistical analysis			x				
Reporting of results				x			
Writing					x		
Preparing and submission for publication						x	x

3. Ethical and legal considerations

Autonomy

This is a low risk descriptive study of an existing database. The retrospective nature thereof makes informed consent from either the patient or the NSRI personnel impossible. Approval to access the National Sea Rescue Institute Database will be obtained from the NSRI management.

Beneficence

The findings of the study will provide valuable information that is likely to influence the preparation and training for rescue operations which will indirectly benefit both the community and the NSRI volunteers in the future.

Justice

Data will be collected anonymously; no personal or identifying information will be obtained. The data will be stored on a password-protected computer and only the researcher team will have access.

We therefore request a waiver of informed consent under the above-mentioned conditions.

4. Limitations

No external method is available to confirm that the Station commander appropriately declared a rescue operation or that the data were recorded accurately at the time of the incident. However, all NSRI personnel are trained on the completion of the rescue mission reports and are routinely subjected to an internal quality assessment. This should increase the quality of the data, while minimising missing data points.

The transcription process will be done by a single investigator. Ten percent of the data will be crosschecked by a research assistant to increase the validity of the data.

Incomplete data forms with missing variables may limit the reliability and the generalizability of the study's results.

5. Reporting and implementation of results

The study results will be reported in a peer reviewed journal. The results will also be distributed to the NSRI management, and other relevant emergency services. The information gained from the study will likely improve preparedness for future rescue operations by the NSRI and assist in implementing search and rescue strategies based on past success. Furthermore, improved preparedness will likely assist in provision of lifesaving medical care in maritime environments.

6. Resources and budget

6.1 Available resources

This study will be self-funded.

6.2 Budget and budget motivation

Personnel Compensation		**R 0**
Principal Investigator	R 0	
Consulting services		**R 0**
Statistical services	R 0	
Travel		**R 100**
Transport and travel cost	R 100	
Equipment & Furniture		**R 0**
Computer	R 0	
Other		**R 1200**
Telephone, cell phone, fax	R 100	
Internet & e-mail	R 100	
Printing, copying & binding	R 1000	
Ethics committee fee	R 0	
Total costs		**R 1300**

Reference:

1. WHO Global Report on Drowning: preventing a leading killer [Internet]. [cited 2015 Jan 27]. Available from: http://www.who.int/violence_injury_prevention/publications/drowning_global_report/Final_report_full_web.pdf?ua=1

2. CDC - Water-Related Injuries Facts - Home and Recreational Safety - Injury Center. [cited 2015 Jan 27]; Available from: http://www.cdc.gov/HomeandRecreationalSafety/Water-Safety/waterinjuries-factsheet.html

3. Peden M, Oyegbite K, Ozanne-Smith J, Hyder AA, Branche C, Rahman AKMF et al. World report on child injury prevention. World Health Organization 2008. [Internet]. 2008 [cited 2015 Jan 27]. Available from: http://whqlibdoc.who.int/publications/2008/9789241563574_eng.pdf

4. Mortality and causes of death in South Africa: Findings from death notification, 2013 [Internet]. [cited 2015 Jan 12]. Available from: http://beta2.statssa.gov.za/publications/P03093/CoD_2013_presentation.pdf

5. Canadian National Search and Rescue Manual [Internet]. [cited 2015 Jan 13]. Available from: http://www.casara.ca/wp-content/uploads/2012/10/NSM_2000.pdf

6. Canadian Coast Guard Auxiliary Search & Rescue Crew Manual [Internet]. [cited 2015 Jan 29]. Available from: http://www.ccga12.org/training/SARCrewManual.pdf

7. Marven C, Canessa R, Keller P. Exploratory Spatial Data Analysis to Support Maritime Search and Rescue Planning. In: Li J, Zlatanova S, Fabbri A, editors. Geomatics Solutions for Disaster Management SE - 18 [Internet]. Springer Berlin Heidelberg; 2007. p. 271–88. Available from: http://dx.doi.org/10.1007/978-3-540-72108-6_18

8. National Search and Rescue Manual Volume I: National Search and Rescue System [Internet]. [cited 2015 Jan 29]. Available from: http://www.public.navy.mil/surfor/Documents/3-50-1_Vol1.pdf

9. MINISTRY TR, POLICE OJA, CIVIL DO, PLANNING EAR. The Norwegian Search and Rescue Service / Informasjonshefter / Redningstjenesten / Redningsnett - Redningsnett [Internet]. 2002 [cited 2015 Jan 29]. Available from: http://www.redningsnett.no/Redningstjenesten/Informasjonshefter/The-Norwegian-Search-and-Rescue-Service

10. Organisation. SAS and R. National SAR manual. National SAR manual. Pretoria, South Africa: South African Search and Rescue; 2007.

11. ISSUU - NSRI Integrated Report 2014 by The Publishing Partnership [Internet]. [cited 2015 Jan 12]. Available from: http://issuu.com/wendymaritz/docs/nsri_-_integrated_report_2014_-_dig

12. About Us | nsri.org.za [Internet]. [cited 2015 Jan 12]. Available from: http://www.nsri.org.za/about/

Appendices

Appendix 1

Sea Rescue
NATIONAL SEA RESCUE INSTITUTE

Activity Capture Form				
Rescue Station:	Weather		Wind speed	
Other Stations Involved:	visibility		wind direction	
Start Date			Sea State (force)	
Start Time				
End Date				
End Time				
Activity Location:			coordinates	
Describe the Activity:				
	Asset 1	**Asset 2**	**Asset 3**	**Asset 4**
NSRI Rescue Units used:				
launch time				
recover time				
Start hrs				
End Hrs				
Water / oil added				
Fuel used: litres				
Sea Rescue Crew involved (& Role) (list in column per asset served)				
Non Sea Rescue Assets used:				
Non Sea Rescue personnel involved				
Final Comments:				

ETHICS APPROVAL NOTIFICATIONS

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Approved with Stipulations
New Application

18-Mar-2015
Erasmus, Elaine E

Ethics Reference #: S15/02/036
Title: The epidemiology of operations performed by the National Sea Rescue Institute of South Africa.

Dear Dr Elaine Erasmus,

The **New Application** received on **02-Mar-2015**, was reviewed by members of **Health Research Ethics Committee 2** via Expedited review procedures on **16-Mar-2015**.

Please note the following information about your approved research protocol:

Protocol Approval Period: **18-Mar-2015 -18-Mar-2016**

The Stipulations of your ethics approval are as follows:
1. Concepts used: Slight confusion between a mission report and a standardised operation capture form - you may need to standardise it.

2. The variables listed in the proposal to be studied differs from those mentioned in the attached instrument (Annexure A) - this anomaly should be addressed please.

Please remember to use your **protocol number** (**S15/02/036**) on any documents or correspondence with the HREC concerning your research protocol.

Please note that the HREC has the prerogative and authority to ask further questions, seek additional information, require further modifications, or monitor the conduct of your research and the consent process.

After Ethical Review:
Please note a template of the progress report is obtainable on www.sun.ac.za/rds and should be submitted to the Committee before the year has expired. The Committee will then consider the continuation of the project for a further year (if necessary). Annually a number of projects may be selected randomly for an external audit.
Translation of the consent document to the language applicable to the study participants should be submitted.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005239

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Medical Research Council Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Provincial and City of Cape Town Approval

Please note that for research at a primary or secondary healthcare facility permission must still be obtained from the relevant authorities (Western Cape Department of Health and/or City Health) to conduct the research as stated in the protocol. Contact persons are Copyright at Western Cape Department of Health (healthres@pgwc.gov.za Tel: Copyright) and Copyright at City Health Copyright Tel: Copyright). Research that will be conducted at any tertiary academic institution requires approval from the relevant hospital manager. Ethics approval is required BEFORE approval can be obtained from these health authorities.

We wish you the best as you conduct your research.
For standard HREC forms and documents please visit: www.sun.ac.za/rds

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Ethics Letter

15-Mar-2016

Ethics Reference #: S15/02/036
Title: The epidemiology of operations performed by the National Sea Rescue Institute of South Africa.

Dear Dr Elaine Erasmus,

The HREC approved the following progress report by expedited review process: Progress Report dated 18/03/2015 - 18/01/2016
The approval of this project is extended for a further year Approval date: 15 March 2016 Expiry date: 14 March 2017

If you have any queries or need further help, please contact the REC Office 219389819.

Sincerely,

REC Coordinator

Health Research Ethics Committee 2

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Ethics Letter

16-Feb-2017
Erasmus, Elaine E

Ethics Reference #: S15/02/036
Title: The epidemiology of operations performed by the National Sea Rescue Institute of South Africa.

Dear Dr Elaine Erasmus

Your request for extension/annual renewal of ethics approval dated 05 February 2017 refers.

The Health Research Ethics Committee reviewed and approved the annual progress report you submitted through an expedited review process.

The approval of the research project is extended for a further year.

Approval date: 16 February 2017

Expiry date: 15 February 2018

Where to submit any documentation
Kindly submit **ONE HARD COPY** to Elvira Rohland, RDSD, Room 5007, Teaching Building, and **ONE ELECTRONIC COPY** to ethics@sun.ac.za

Please remember to use your **protocol number** **(S15/02/036)** on any documents or correspondence with the HREC concerning your research protocol.

Federal Wide Assurance Number: 00001372
Institutional Review Board (IRB) Number: IRB0005240 for HREC1
Institutional Review Board (IRB) Number: IRB0005239 for HREC2

The Health Research Ethics Committee complies with the SA National Health Act No.61 2003 as it pertains to health research and the United States Code of Federal Regulations Title 45 Part 46. This committee abides by the ethical norms and principles for research, established by the Declaration of Helsinki, the South African Good Clinical Pracices Guidelines as well as the Guidelines for Ethical Research: Principles Structures and Processes 2004 (Department of Health).

Sincerely,

REC Coordinator
Health Research Ethics Committee 2

AUTHOR GUIDELINES: INTERNATIONAL MARITIME HEALTH

(Available from: https://journals.viamedica.pl/international_maritime_health/about/submissions#authorGuidelines)

This journal follows editorial recommendations of International Committee of Medical Journal Editors (ICMJE) (available at http://www.icmje.org/recommendations/).

Via Medica strongly recommends journal editors to adhere to the principles of Committee on Publication Ethics (COPE), particularly to deal with acts of ethical misconduct. For more information Authors, Readers and Editors may visit the COPE website: http://publicationethics.org/.

The International Maritime Health will publish original papers on medical and health problems of seafarers, fishermen, divers, dockers, shipyard workers and other maritime workers, as well as papers on tropical medicine, travel medicine, epidemiology, and other related topics.

Manuscripts:

Typical length of such a paper would be 2000-4000 words, not including tables, figures and references. Its construction should follow the usual pattern: abstract (structured abstract of no more than 300 words); key words; introduction; participants; materials; methods; results; discussion; and conclusions/key messages. Please do not provide the authors details (personal details and institutional affiliations) in the file containing the text of the paper, as the reviews are anonymous: neither the reviewer knows who has authored the paper nor the authors know who has reviewed their paper. All papers will be double blind peer-reviewed. The comments made by the reviewers will be sent to authors, and their criticism and proposed amendments should be taken into consideration by authors submitting revised texts

Case Reports will also be accepted, particularly of work-related diseases and accidents among maritime workers.

Review articles on specific topics, exposures, preventive interventions, and on the national maritime health services will also be considered for publication. Their length will be from 1000 to 4000 words, including tables, figures and references.

Letters to the Editor discussing recently published articles, reporting research projects or informing about workshops will be accepted; they should not exceed 500 words of text and 5 references.

There also will be the section Chronicle, in which brief reports will be published on the international symposia and national meetings on maritime medicine and health, on tropical parasitology and epidemiology, on travel medicine and other subjects related to the health of seafarers and other maritime workers. Information will also be given on training activities in this field, and on international collaborative projects related to the above subjects.

All articles should be submitted to International Maritime Health electronically online at **www.intmarhealth.pl** where detailed instruction regarding submission process will provided.

Only English texts will be accepted.

Manuscripts should be typed in double line spacing on numbered pages and conform to the usual requirements (Ref.: International Committee on Medical Journals Editors. Uniform Requirements for Manuscripts Submitted to Biomedical Journals, JAMA, 1997; 277; 927-934).

Only manuscripts that have not been published previously, and are not under consideration by another publisher, will be accepted.

Full texts of oral presentations at meetings (with abstracts printed in the conference materials) can be considered.

All authors must give written consent to publication of the text.

Manuscripts should present original material, the writing should be clear, study methods appropriate, the conclusions should be reasonable and supported by the data. Abbreviations, if used, should be explained.

Drugs should be referred to by their approved names (not by trade names). Scientific measurements should be given in SI units, except for blood pressure, which should be expressed in mm Hg.

Authors should give their names, addresses, and affiliations for the time they did the work. A current address of one author should be indicated for correspondence, including telephone and fax numbers, and e-mail address.

All financial and material support for the reported research and work should be identified in the manuscript.

References

The style of references is that of Index Medicus/NLM:(http://www.nlm.nih.gov/bsd/policy/cit_format.html). References should be numbered in the order in which they appear in the text. At the end of the article the full list of

references should give the names and initials of first three authors should be given followed by: et al.).

The authors' names are followed by the title of the article; the title of the journal abbreviated according to Medline; the year of publication, the volume number; and the first and last page numbers.

PLEASE NOTE: It is recommended to include DOI numbers of the cited papers (if applicable) – it will enable the references to be linked out directly to proper websites. (e.g. Redon J, Cifkova R, Laurent S et al. Mechanisms of hypertension in the cardiometabolic syndrome. J Hypertens 2009; 27: 441–451. doi: 10.1097/HJH.0b013e32831e13e5.).

Reference to books should give the title, names of authors or of editors, publisher, place of publication, and the year.

Information from yet unpublished articles, papers reported at meetings, or personal communications should be cited only in the text, not in References.

AUTHORSHIP

All collaborators who have made significant and substantial contributions to a study are considered co-authors. The nature and level of contribution of all authors of accepted manuscripts must be indicated, i.e. conception, design, execution and interpretation of the data being published, wrote the paper. An author may list more than one contribution, and more than one author may have contributed to the same aspect of the work. Other contributions to the work, such as providing of reagents or analytic tools, should be listed in the Acknowledgements. Ghost-writing and guest-authorship are forbidden. In case of detecting ghost written manuscripts, actions will be taken involving both the submitting authors and the participants involved.

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LETTER OF ACCEPTANCE

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Dr. Elaine Erasmus

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Faculty of Medicine and Health Sciences

PO Box 240, 8000 Cape Town, South Africa

e-mail: Copyright

Gdansk, February 8, 2018

Dear Dr. Elaine Erasmus

Please be kindly informed that the article entitled:

"The epidemiology of operations performed by the National Sea Rescue Institute of South Africa over a 5-year period"

(Authors: Elaine Erasmus, Daniel Jacobus van Hoving, Cleeve Robertson)

has been published in the journal "International Maritime Health"

Best regards,

Copyright

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